First look on the drift time distribution in 2004 muon data

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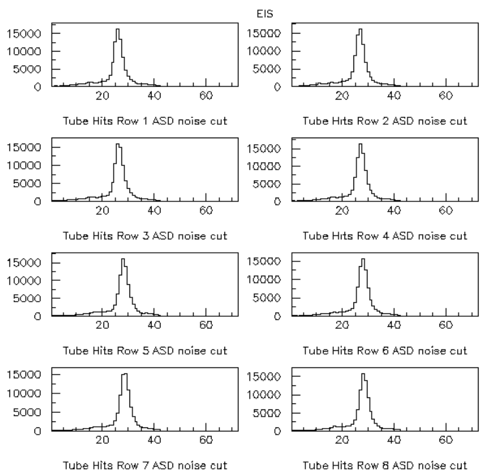
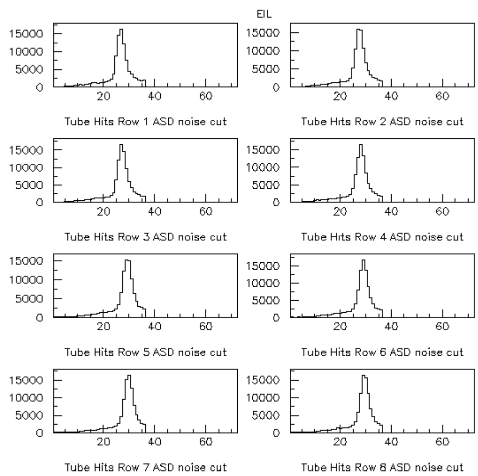
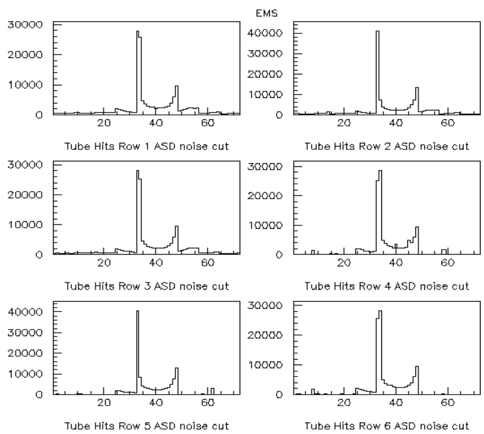
The analysis was performed using the recent version of the mutrak program. The analysis was run for six endcap chambers (EIS, EIL, EMS, EML, EOS, EOL) and for runs 601481, 601491, 601492, 601493, 601495, 601497 and 601500. These runs were taken on August 26-27 with a HODO trigger:

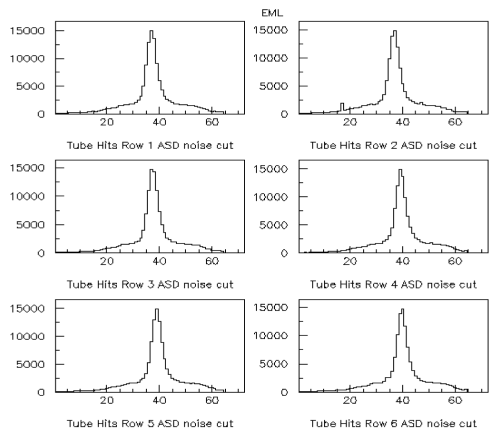
- *601481 26-Aug 12:25-14:11 122 k*
- *601491 26-Aug 16:05-16:23 168 k*
- *601492 26-Aug 16:25-16:31 50 k*
- *601493 26-Aug 16:30-16:45 54 k*
- *601495 26-Aug 16:51 150 k*
- *601497 26-Aug 17:15-17:45 k*
- *601500 27-Aug 7:57 250 k*

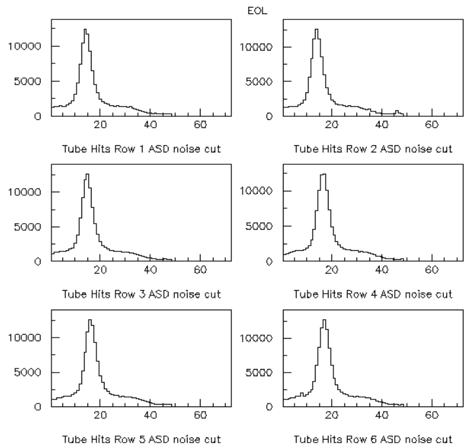
In these runs EOS chamber did not collect any data (was off?). In other chambers the beam profiles are as follows.





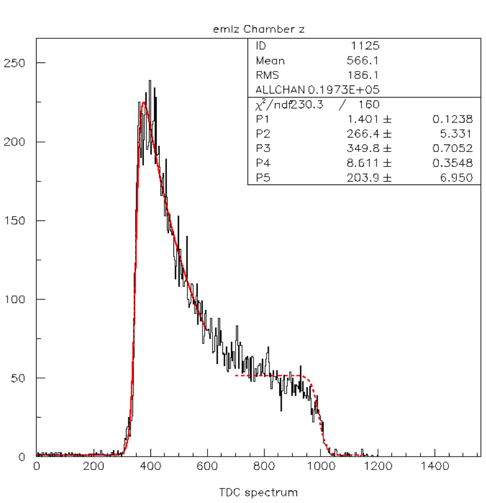




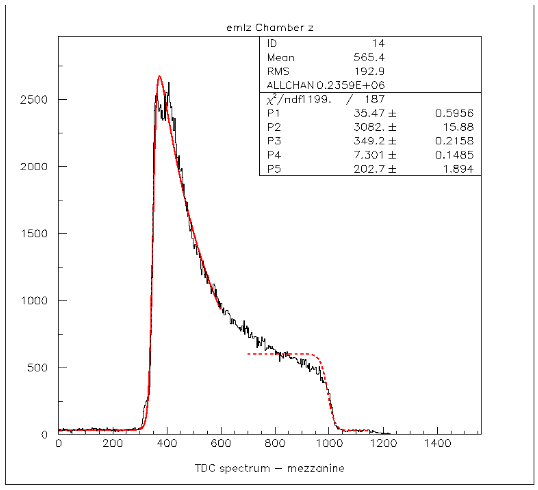


As we can see, the beam profile for the EML chamber looks a little bit strange.

The TDC time spectra were produced for each tube in the chamber. Also separate histograms for each mezzanine were filled. They have, of course, much better statistics. The TDC times were taken from the ntuple and were corrected by the trigger time. The charge cut was put at 40.
There were two functions fitted separately to the TDC spectrum, one to find the starting time t_0 and the second to fit t_1. Not all the histograms had enough statistics to perform the fit (at least 5000 entries were required). Typical fits for a single mezzanine and for a single tube are shown below.



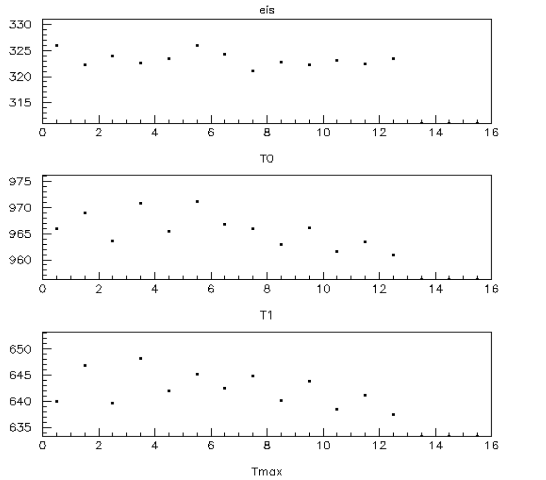
EML chamber, tube 1125



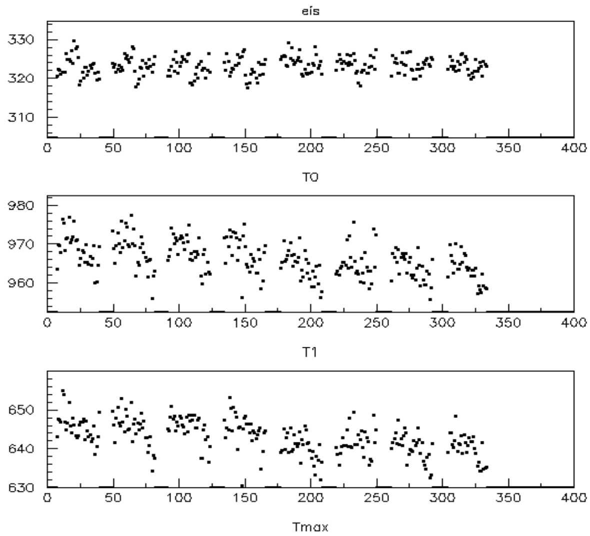
EML chamber, mezzanine 14

Drift times, t_0 and t_1 fits

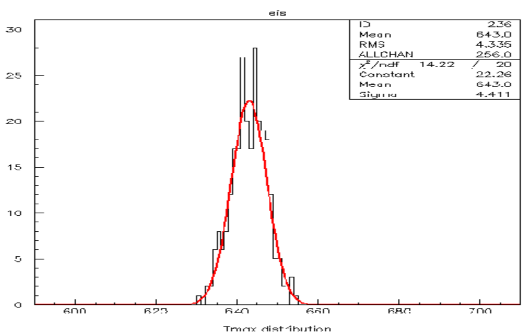
EIS chamber



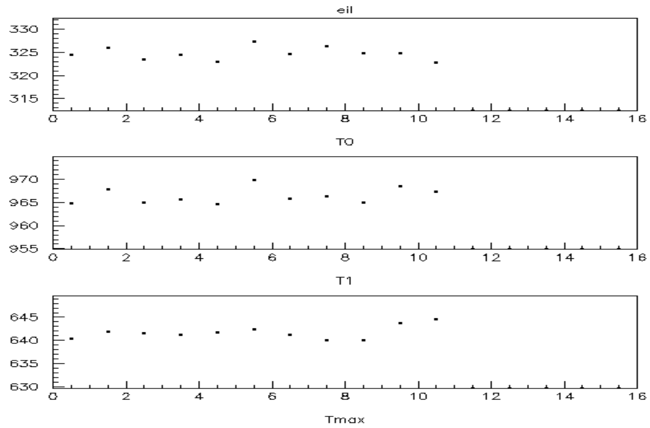
The plot above shows the t_0, t_1 and a drift time for the EIS chamber. The t_0 distribution is quite flat, while t_1's tend to show some structure or fluctuate. While inspecting the fits the look fine, so the fit itself is not failing. The effect seems to be real.



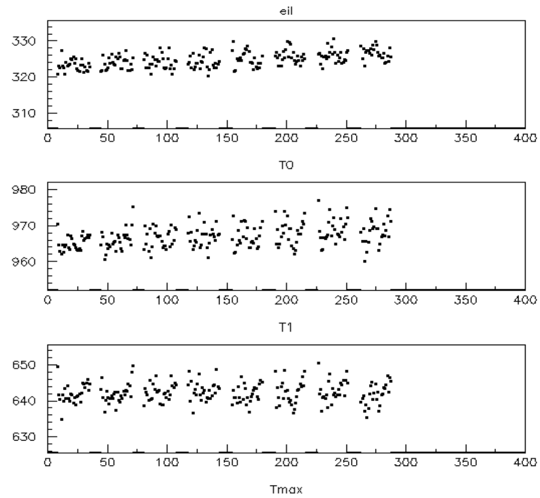
When we look at the t_0, t_1 and a drift times for a single tube we see the same efect, some patterns are repeated. Therefore the distribution of the drift times is quite broad (sigma = 4.4 ns, two peaks can be seen).

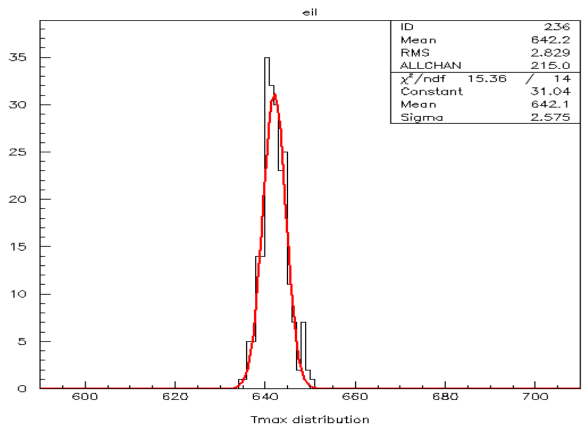


EIL chambers



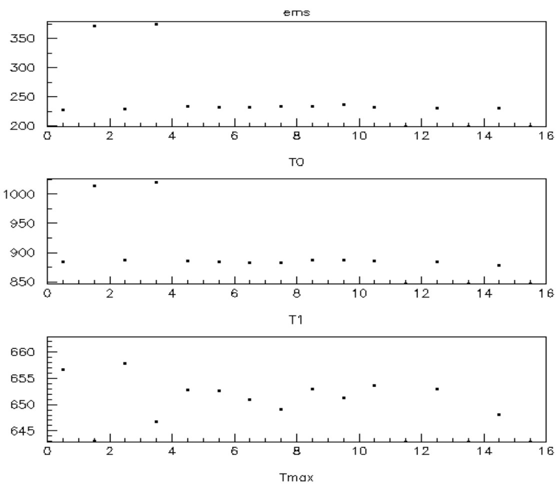
The times are quite uniform over mezzanines and over single tubes (below). The t_0 is growing for higher tube numbers (i.e. higher layers).



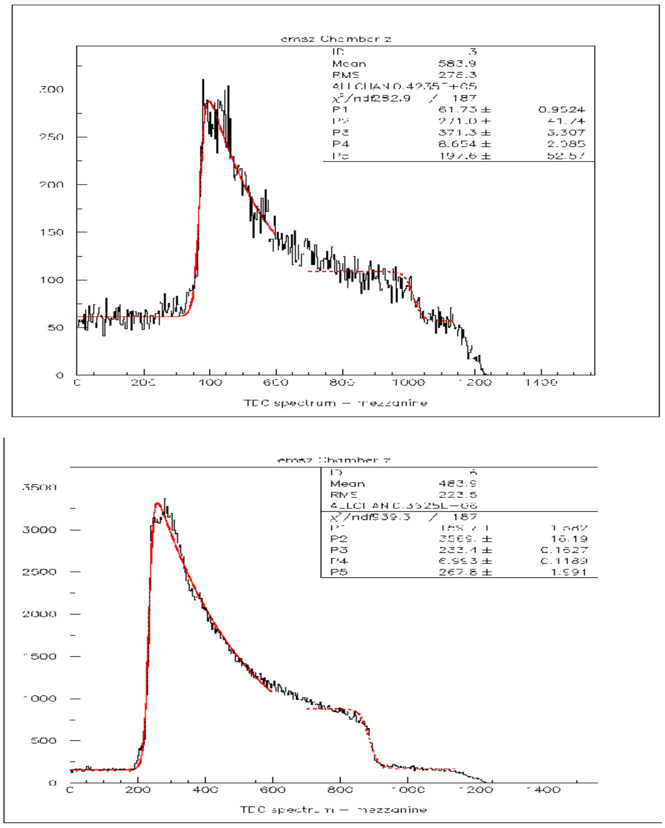


The drift time distribution is much narrower, sigma=2.6 ns.

EMS chamber

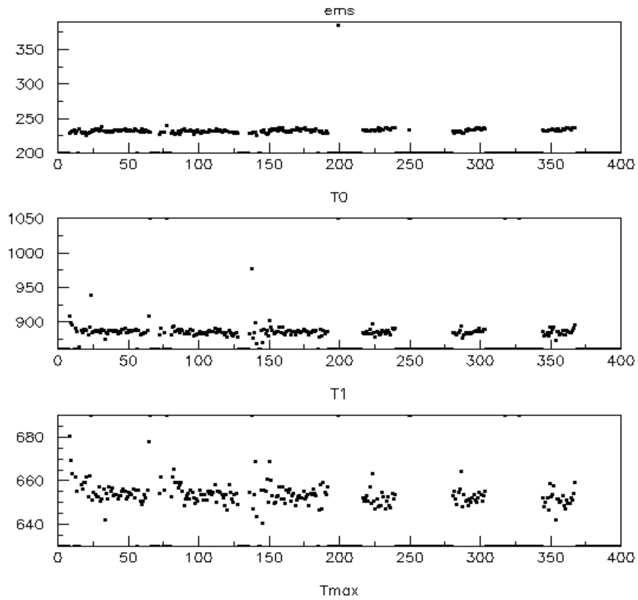


As we can see here, three mezzanines (#1, #3 and #5) have some tdc offset. Both t_0 and t_1 are much longer than for other mezzanines, while the drift times do not differ so much (watch the different vertical scales). Below I compare the tdc spectra, they are significantly different.

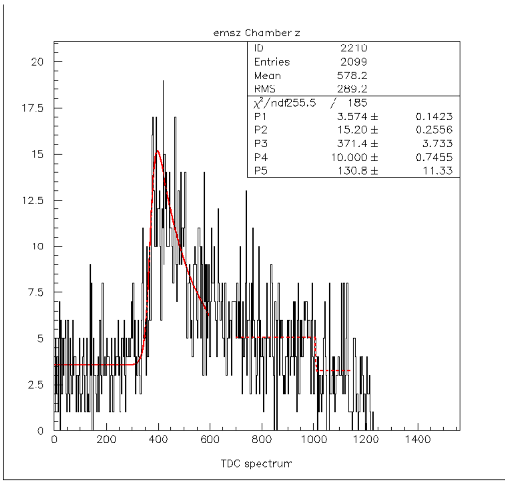


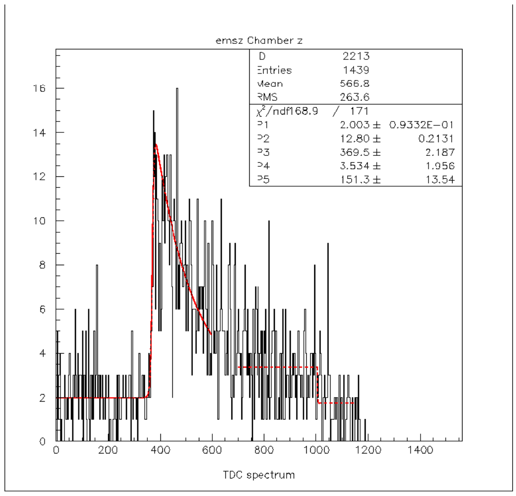
Drift time spectra for mezzanine #3 (top) and for mezzanine #6 (bottom). A strong shift can be seen.

Of course similar effect should be seen also for the drift times for single tubes. But the mezzanines with this significant shift also collected quite little data, so no fit was possible for a single tube.

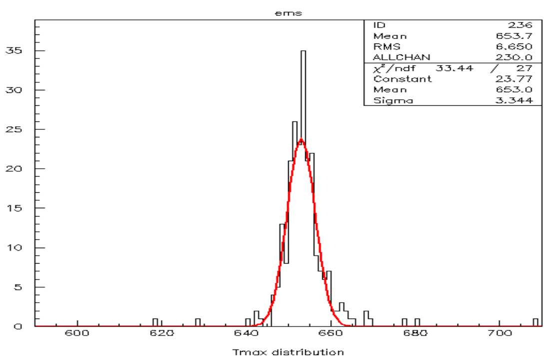


Below two tdc spectra from tubes connected to mezzanine #3 are shown. They indeed have a low statistics, but the strong shift in t_0 can be seen.

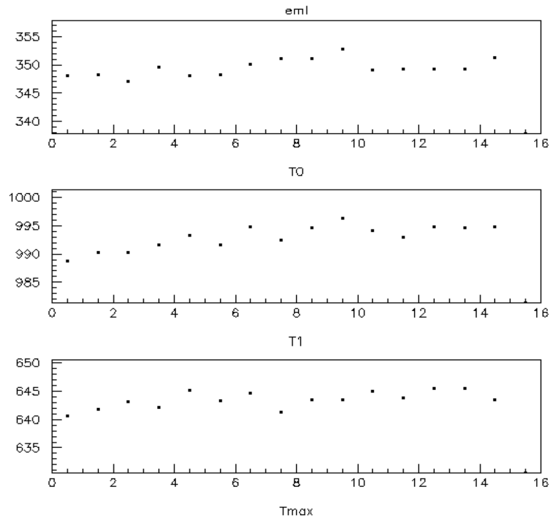




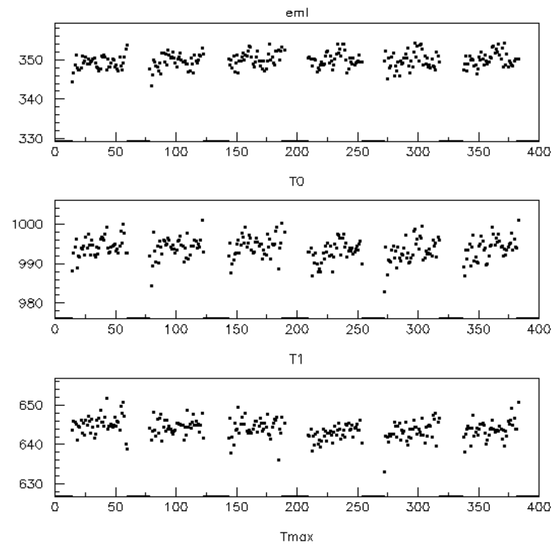
The sigma of the drift time distribution is quite small (see below).



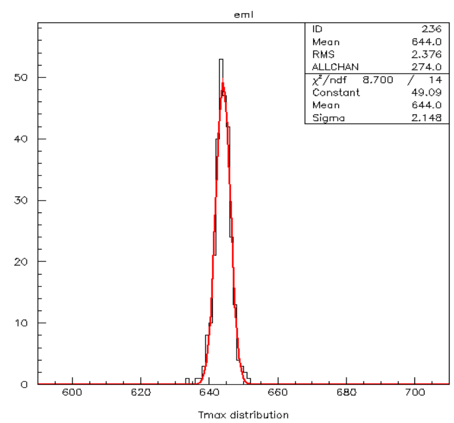
EML chamber



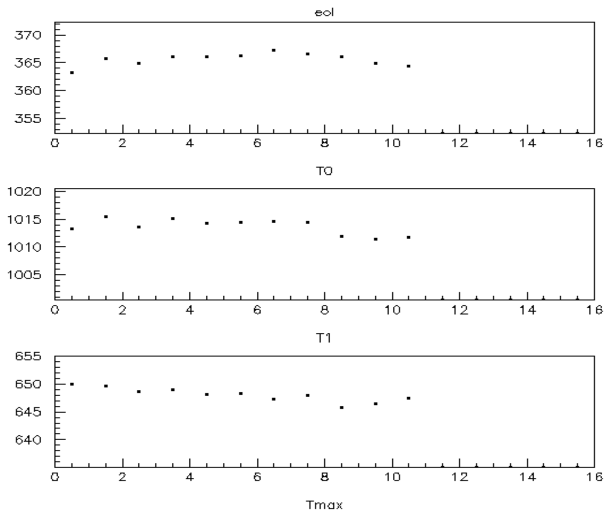
Maybe some structure could be seen. In general quite flat distribution, slightly longer t_0 and t_1 for higher mezzanine number.



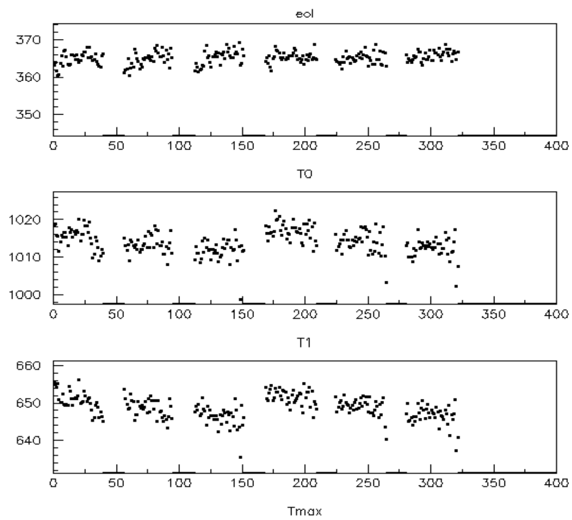
Quite stable drift times, narrow drift time distribution (sigma = 2.1 ns).



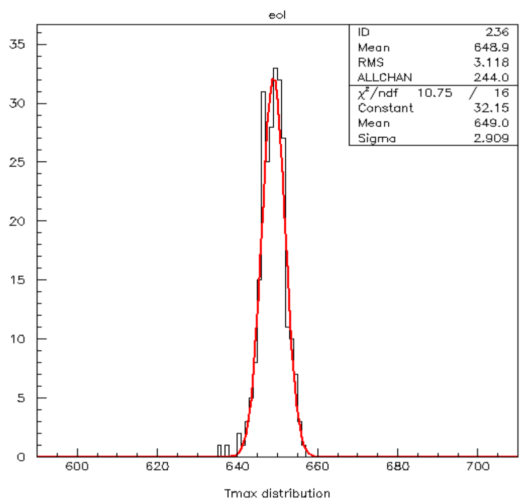
EOL chamber



Flat distribution, stable drift times.



Drift times are getting shorter for the higher layers. Also the drift time distribution is slightly wider, about sigma = 2.9 ns.



Noise estimation

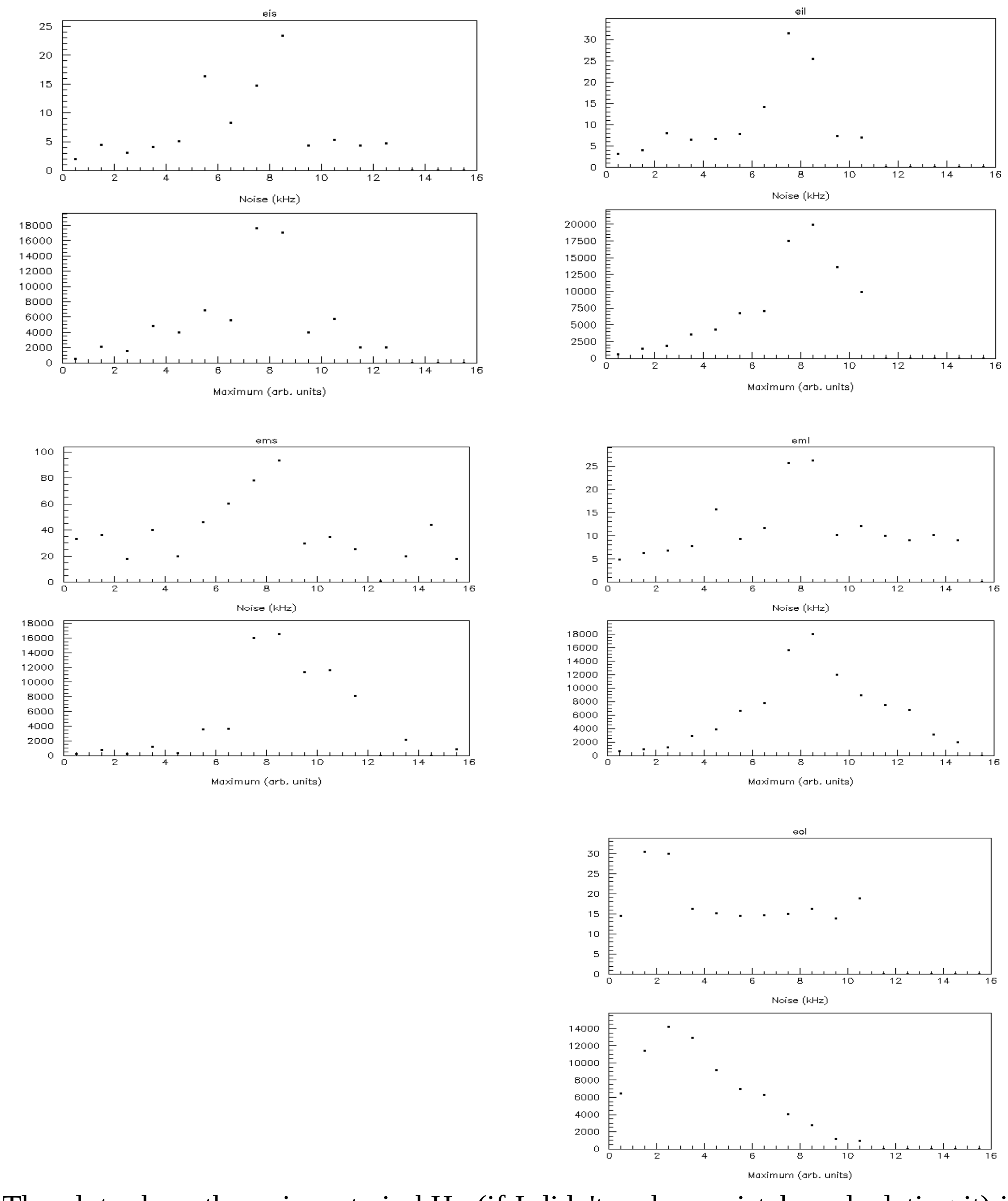
From the height of the flat part of the TDC spectrum before t_0 we estimate the noise level. Since we analyze $N_{events,}$,

$$f_{noise} = N_{noise}/N_{events}/dT$$

where dT is the width of the trigger window (about 1200 ns, but I could be wrong) and $N_{noise}=P_1*dT/(\text{bin width})$. P1 is the value of the the parameter obtained from the fit. So finally:

$$f_{noise} = P_1/N_{events}/(\text{bin width})$$

We got in total 1 114 106 events, the bin with is 3.125 ns.



The plots show the noise rate in kHz (if I didn't make a mistake calculating it) in the upper part, in the lower part is the maximum of the TDC spectrum, proportional to the number of entries. It is proportional to the illumination. The plots show the noise rate

per mezzanine.
It should be noticed, that the noise frequency grows with the growing illumination of the tube It could mean, that a significant part of hits with TDC times before t_0 comes from real, off-time particles.